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Updates:

Database Foundations
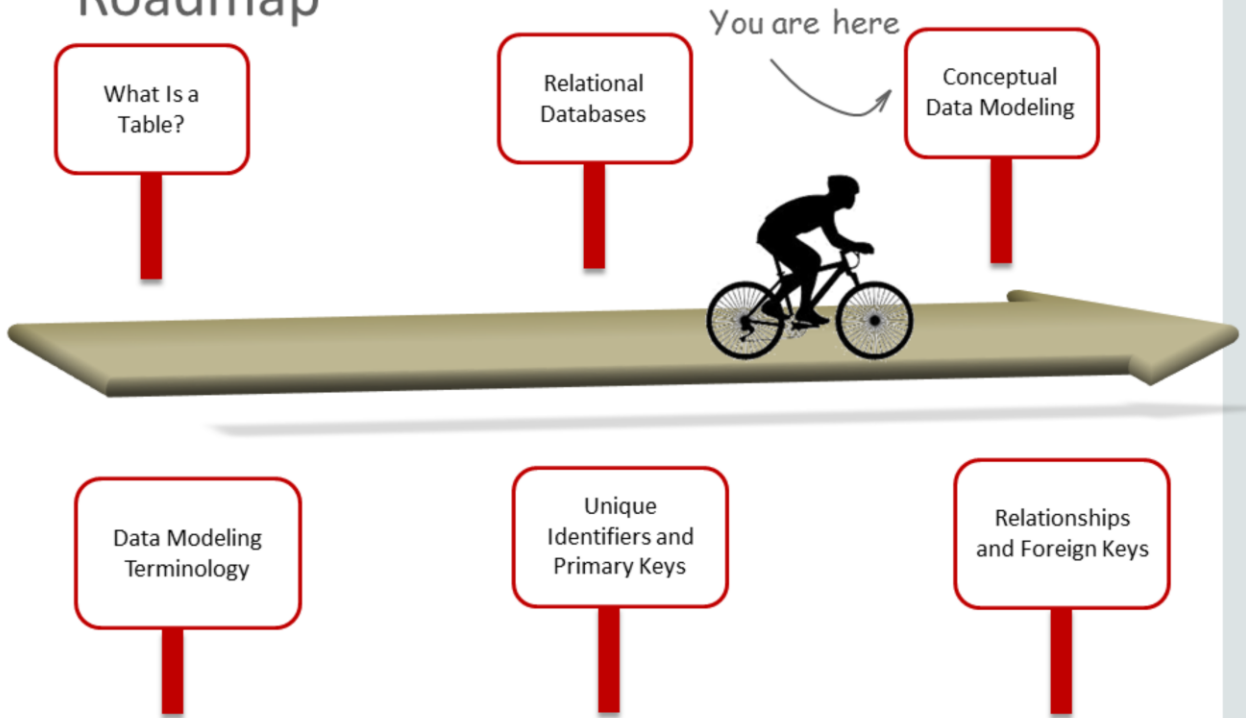
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Conceptual Data Modeling

Roadmap

What Is a Table?

Relational Databases

You are here

Conceptual Data Modeling

Data Modeling Terminology

Unique Identifiers and Primary Keys

Relationships and Foreign Keys

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Objectives

This lesson covers the following objectives:

- Describe a conceptual data model
- Explain "implementation-free" as it relates to data models and database design implementation
- List the four goals of entity relationship modeling
- Identify an entity relationship diagram (ERD)
- Construct ERD components that represent entities and attributes according to diagramming conventions

Purpose of Conceptual Modeling

- When you design a house, you eventually want to see the house built.

- Even if you don't do the actual construction, you need to understand the builder's terms to help them take your conceptual design and make it a physical reality.

- The database conceptual model can be used for further discussion between designers, database administrators, and application developers.

It would be unthinkable to build a house without a plan or blueprint. Initially, the house may only exist in the mind of the future homeowners as ideas, or as pieces of various dreams. Sometimes the future homeowners may not even know what they want, or know whether what they want is even possible. The ideas may be full of internal contradictions and impossibilities.

This is not a problem in a dream world, but in the physical realm any inconsistencies and obstacles must be resolved before someone can start to construct a house. A building contractor needs a solid plan: a blueprint of the house with an exact description of the materials to be used, the size of the roof beams, the capacity of the plumbing, and many other specifications. The builder follows the plan and has the knowledge to construct what is in the blueprint. For the blueprint to be completed, the architect works with the future homeowner to take the ideas and desires and build a model that is feasible for the building contractor to create.

The architect is trained in the skills of translating ideas into models. The architect listens to the description of the ideas and asks many questions that are then put into a diagram (the blueprint) that allows for discussion and analysis, giving advice, describing sensible options, documenting it, and confirming it with the future homeowners. This diagram provides the future homeowners with a plan of the home they want.

Conceptual Modeling

- A conceptual data model identifies the highest-level relationships between the different entities.

- It contains relationships between entities, but may or may not include cardinality and nullability.

- It does not specify the primary key, but it does determine a unique identifier for each entity.

A conceptual model is a formal model in which every table being modeled in the real world has a corresponding object in the model. It describes the things of significance to an organization (*entities),* about which it collects information, characteristics (*attributes)* of these entities, and associations between pairs of entities (*relationships).*

The conceptual modeling has a formal analysis and design method that uses a set of guidelines and rules to capture the semantics of a domain. Formal methods include textual or graphical notations to create, present, validate, and manipulate data models. It clarifies identification of entities, attributes, and relationships. It provides a basis for discussion and refinement.

A conceptual model is important to a business because it:

- Describes the exact information needs of the business

- Facilitates discussion

- Prevents mistakes and misunderstandings

- Forms a sound basis for physical database design

- Documents the processes (also known as *business rules*) of the business

- Takes into account regulations and laws governing this industry

Conceptual Modeling Components: Entities

- Real-world object or thing that has an independent existence and that is distinguishable from other objects
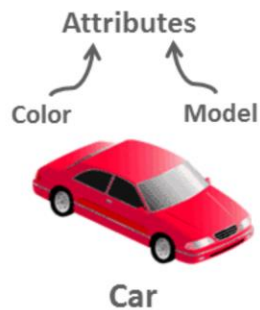
- Examples: person, car, customer

Person

Car

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Entities are the real-world objects or things that are distinguishable from other objects.

Conceptual Modeling Components: Attributes
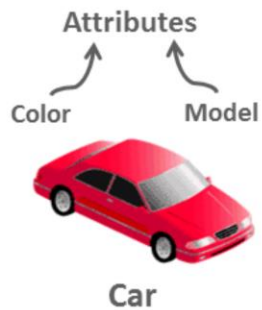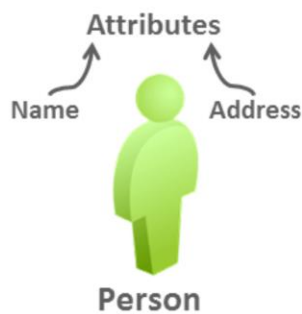
- Characteristics of entities or relationships that provide descriptive details about them
- Examples: person's name, address

Attributes
Name ↗ ↖ Address
Person

Attributes
Color ↗ ↖ Model
Car

Attributes defines the characteristics of the entities.

Conceptual Modeling Components: Relationships

- Association among two or more entities

Attributes

Name — Person — Address

Person
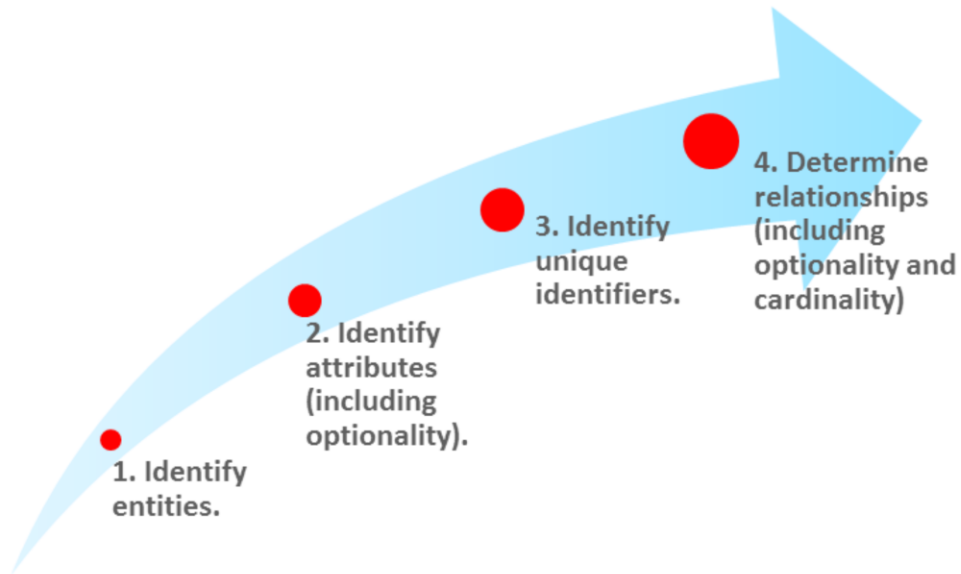
Attributes

Color — Car — Model

Car

Person drives a car.

↓

Relationship

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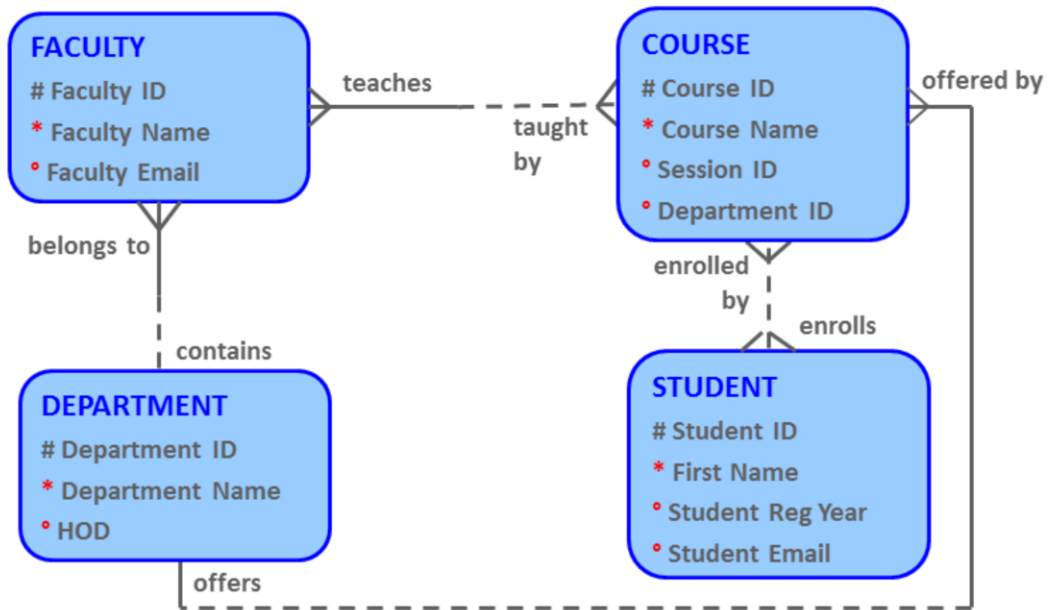We represent the conceptual model using an ERD. Hence the components of conceptual modeling are:

- Entities
- Attributes
- Relationships

The slide shows the steps to create a conceptual model.

The slide shows an example of a conceptual model.

Entity Relationship Diagram

- A consistent tool that can be used to represent the data requirements of a business, regardless of the type of database that is used, and even in the absence of one.

- A graphical representation of entities and their relationships to each other, and it is used to organize data within databases or information systems.
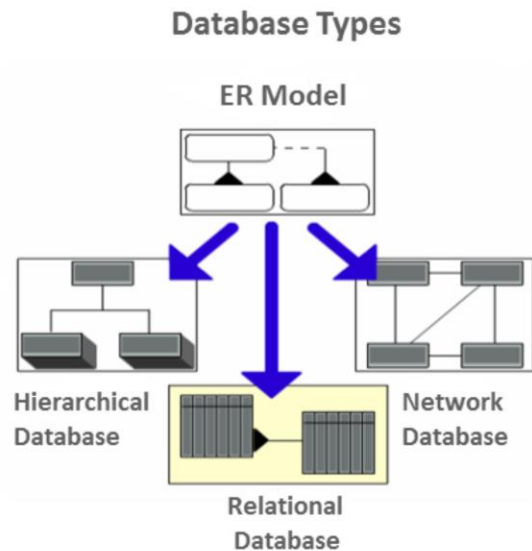
ERD is a model that identifies the concepts or entities that exist in a system and the relationships between those entities.

It serves several purposes:

- The database analyst/designer gains a better understanding of the information to be contained in the database through the process of constructing the ERD.

- It serves as a documentation tool.

- It is used to communicate the logical structure of the database to users. In particular, it effectively communicates the logic of the database to users.

Implementation-Free Models

- A good conceptual data model stays the same regardless of the type of database system that is eventually built—or implemented—on.

- This is what "implementation-free" model means.

Database Types

ER Model

Hierarchical Database

Network Database

Relational Database

The data model should stay the same even if a database is not used at all; for example, when the data is eventually stored on pieces of paper in a filing cabinet.

Entity Relationship Model

- Is a list of all entities and attributes as well as all relationships between the entities that are of importance.

- Provides background information such as entity descriptions, data types, and constraints.

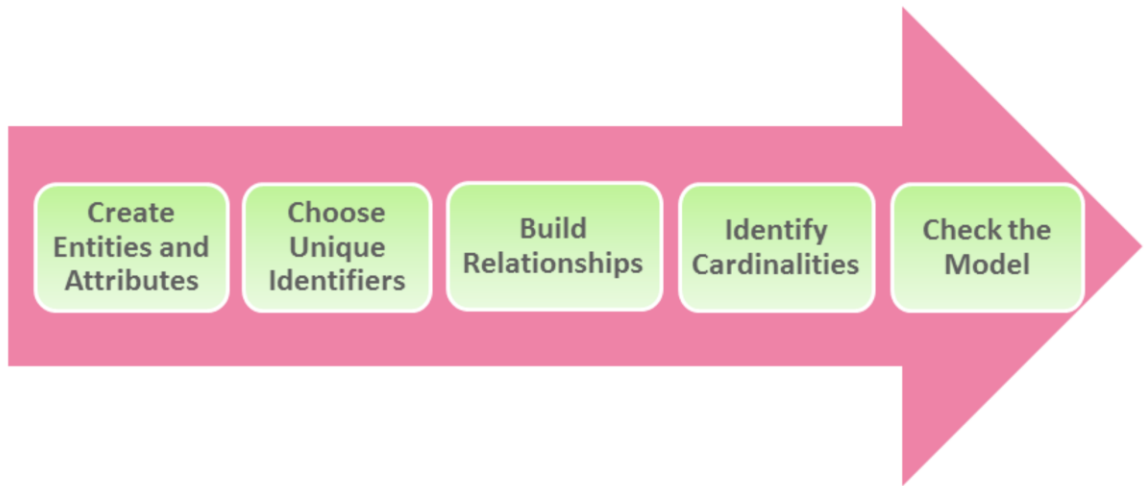- Does not require a diagram, but the diagram is typically a very useful tool.

The entity relationship model (ERM) is derived from business specifications, and its intended goal is to create a clear picture of the information that will be stored in a future database.

Goals of ER Modeling

- Capture all required information.
- Ensure that information appears only once.
- Model no information that is derivable from other information that is already modeled.
- Locate information in a predictable, logical place.

Consider your school record. From your earliest days, data about you was captured. Your absences, disciplinary history, classes taken, and grades earned are probably part of your record.

Steps to Build an ERD

Create Entities and Attributes → Choose Unique Identifiers → Build Relationships → Identify Cardinalities → Check the Model

The slide shows the steps to build an ERD.

Sporting Goods Business Scenario

I'm a manager of a sporting goods wholesale company that operates worldwide to fill orders of retail sporting goods stores. The stores are our customers (some of our people prefer to call them our clients).

Right now we have fifteen customers worldwide, but we're trying to expand our customer base by about 10% each year starting this year.

Read the business scenario for the sporting goods company, and then examine the completed ERD.

Sporting Goods Business Scenario

Our two biggest customers are in the United States: Big John's Sports Emporium in San Francisco, California, and Women's Sports in Seattle, Washington.

For each customer, we must track an ID and a name. We may also track an address (including the city, state, zip code, and country) and a phone number.

We maintain warehouses in different regions to fill our customer orders.

Sporting Goods Business Scenario

For each order, we must track an ID. We may also track the date ordered, date shipped, and payment type if the information is available. Our order entry personnel are well versed in our product line.
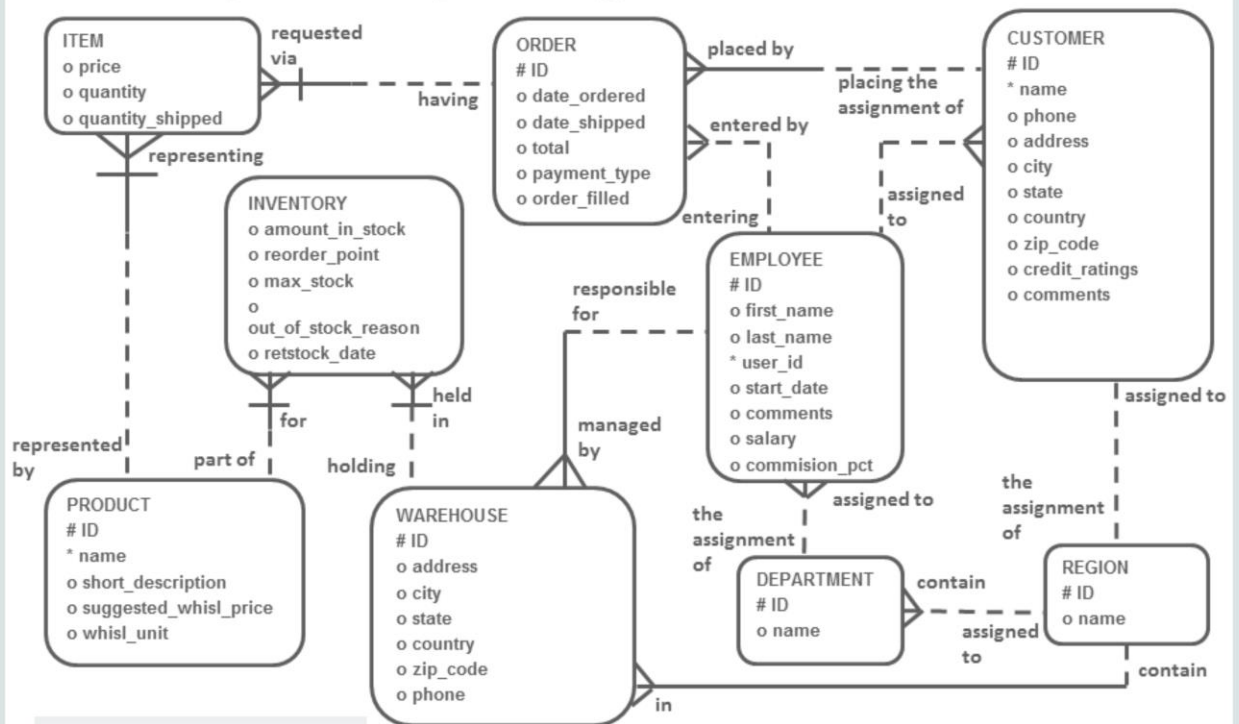
We hold frequent meetings with Marketing to learn about new products. The result is better customer satisfaction because we can answer customer questions.

Sporting Goods Business Scenario

We deal with a few select customers and maintain a specialty product line. For each product, we must know the ID and name. Occasionally we must also know the description, suggested price, and unit of sale.

When necessary we also want to be able to track very long descriptions of our products and pictures of our products.

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This slide shows the completed Sporting Goods ERD.

Summary

In this lesson, you should have learned how to:

- Describe a conceptual data model
- Explain "implementation-free" as it relates to data models and database design implementation
- List the four goals of entity relationship modeling
- Identify an ERD
- Construct ERD components that represent entities and attributes according to diagramming conventions